

Claims

- [c1] 1. A method of fabricating a polysilicon thin film, comprising:
- forming a first solid phase silicon layer having a plurality of first protrusions with different heights on a substrate, wherein the maximum distance between the top of said first protrusions and the surface of said substrate is X_1 , and the minimum distance between the top of said first protrusions and the surface of said substrate is Y_1 ;
- liquidizing a portion of said first solid phase silicon layer such that a portion of said first protrusions having a distance which is between the top of said first protrusions and the surface of said substrate and larger than Z_1 wherein $Y_1 < Z_1 < X_1$, is not liquidized and becomes a plurality of silicon grains; and
- performing a crystallization process using said silicon grains as crystalline seeds.
- [c2] 2. The method of fabricating a polysilicon thin film of claim 1, wherein said step of forming said first solid phase silicon layer comprises:
- forming a first polysilicon layer on said substrate, wherein said first polysilicon layer has a plurality of

polysilicon protrusions with different heights; and forming a first amorphous silicon layer on said first polysilicon layer.

[c3] 3. The method of fabricating a polysilicon thin film of claim 2, wherein the step of forming said first polysilicon layer comprises:

forming a second amorphous silicon layer on said substrate;

applying a laser power to said second amorphous silicon layer to fuse a portion of said second amorphous silicon layer, wherein said fused portion of said second amorphous silicon layer is a second liquid silicon layer, and said unfused portion of said second amorphous silicon layer forms a plurality of amorphous silicon grains; and crystallizing said second liquid silicon layer to form said first polysilicon layer by using said amorphous silicon grains as crystalline seeds.

[c4] 4. The method of fabricating a polysilicon thin film of claim 2, wherein said liquidizing step of said first solid phase silicon layer comprises:

applying a laser power to said first solid phase silicon layer to fuse a thickness of Z_1 of said first solid phase silicon to be a first liquid silicon layer.

[c5] 5. The method of fabricating a polysilicon thin film of

claim 4, wherein said laser power is generated by an excimer laser.

[c6] 6. The method of fabricating a polysilicon thin film of claim 4, further comprising lowering the temperature to crystallize said first liquid silicon layer to form said polysilicon thin film by using said silicon grains as crystallization seeds.

[c7] 7. The method of fabricating a polysilicon thin film of claim 6, wherein the thickness of said first polysilicon layer is between 1nm and 1000nm.

[c8] 8. The method of fabricating a polysilicon thin film of claim 6, further comprising forming an isolating layer between said substrate and said first polysilicon layer.

[c9] 9. The method of fabricating a polysilicon thin film of claim 1, wherein said first solid phase silicon layer is a first polysilicon layer, and the step of forming said first polysilicon layer comprises:
forming a second amorphous silicon layer on said substrate;
applying power to said second amorphous silicon layer to fuse a portion of said second amorphous silicon layer, wherein said fused portion of said second amorphous silicon layer is a second liquid silicon layer, and said un-

fused portion of said second amorphous silicon layer forms a plurality of amorphous silicon grains; and crystallizing said second liquid silicon layer to form said first polysilicon layer by using said amorphous silicon grains as crystallization seeds, wherein said first polysilicon layer has said a plurality of first protrusions with different heights.

[c10] 10. The method of fabricating a polysilicon thin film of claim 9, wherein said liquidizing step of said first solid phase silicon layer comprises:
etching said first solid phase silicon layer to make a thickness of Z_1 of said first solid phase silicon layer gaseous;
forming a third amorphous silicon layer on said substrate and said silicon grains; and
applying a laser power to said third amorphous silicon layer and said silicon grains to fuse said third amorphous silicon layer to become a third liquid silicon layer and said silicon grains are not fused completely.

[c11] 11. The method of fabricating a polysilicon thin film of claim 10, wherein said etching step is anisotropic etching.

[c12] 12. The method of fabricating a polysilicon thin film of claim 10, further comprising:

crystallizing said third liquid silicon layer to form said first polysilicon layer by using said silicon grains as crystalline seeds.

[c13] 13. The method of fabricating a polysilicon thin film of claim 12, wherein the thickness of said first polysilicon layer is between 1nm and 1000nm.

[c14] 14. The method of fabricating a polysilicon thin film of claim 10, wherein said power is generated by an excimer laser.

[c15] 15. The method of fabricating a polysilicon thin film of claim 9, further comprising forming an isolating layer between said substrate and said first polysilicon layer.

[c16] 16. A method of fabricating a polysilicon thin film, comprising:

forming a first polysilicon layer on a substrate, wherein said first polysilicon layer has a plurality of first protrusions with different heights, and the maximum distance between the top of said first protrusions and the surface of said substrate is X_1 , and the minimum distance between the top of said first protrusions and the surface of said substrate is Y_1 ;

forming a first amorphous silicon layer on said first polysilicon layer;

performing a first annealing process to liquidize said first protrusions having a thickness of Z_1 to form a plurality of second protrusions, wherein $Y_1 < Z_1 < X_1$ and the number of said second protrusions is less than the number of said first protrusions; and
performing a crystallization process using said second protrusions as crystallization seeds to form a second polysilicon layer.

[c17] 17.The method of fabricating a polysilicon thin film of claim 16, wherein said step of forming said first polysilicon layer comprises:

forming a second amorphous silicon layer on said substrate;

performing a second annealing process to fuse a portion of said second amorphous silicon layer, wherein the unfused portion of said second amorphous silicon layer is amorphous silicon grains set on the surface of said substrate; and

using said amorphous silicon grains as crystalline seeds to perform crystallization to form said first polysilicon layer.

[c18] 18.The method of fabricating a polysilicon thin film of claim 16, further comprising forming an isolating layer between said substrate and said first polysilicon layer.

[c19] 19. A method of fabricating a polysilicon thin film, comprising:

forming a first polysilicon layer on a substrate, wherein said first polysilicon layer has a plurality of first protrusions with different heights, and the maximum distance between the top of said first protrusions and the surface of said substrate is X_2 , and the minimum distance between the top of said first protrusions and the surface of said substrate is Y_2 ;

etching a portion of said first polysilicon layer to remove said first protrusions and said first polysilicon layer having a thickness of Z_2 to form a plurality of second protrusions on said substrate, wherein $Y_2 < Z_2 < X_2$ and the number of said second protrusions is less than the number of said first protrusions;

forming a first amorphous silicon layer on said substrate and said second protrusions; and

performing a first annealing process to crystallize to form a second polysilicon layer by using said second protrusions as crystalline seeds.

[c20] 20. The method of fabricating a polysilicon thin film of claim 19, wherein said step of forming said first polysilicon layer comprises:

forming a second amorphous silicon layer on said substrate;

performing a second annealing process to fuse a portion of said second amorphous silicon layer, wherein the unfused portion of said second amorphous silicon layer is amorphous silicon grains set on the surface of said substrate; and

performing a crystallization process using said amorphous silicon grains as crystallization seeds to form said first polysilicon layer.